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(54) **IDENTIFYING REVOKED CREDENTIALS**

(71) Applicant: **Workday, Inc.**, Pleasanton, CA (US)

(72) Inventors: **Bjorn Hamel**, Dublin, CA (US); **Jonathan David Ruggiero**, Danville, CA (US)

(73) Assignee: **Workday, Inc.**, Pleasanton, CA (US)

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H04L 9/40	(2022.01)

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(52) **U.S. Cl.**

CPC ***H04L 63/083*** (2013.01); ***G06F 16/27*** (2019.01); ***G06F 21/31*** (2013.01); ***G06F 21/45*** (2013.01);

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CPC ... H04L 63/083; H04L 9/0891; H04L 9/3247; G06F 16/27; G06F 21/31; G06F 21/45; G06F 21/604; G06F 21/6245

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,662,299	B1	12/2003	Price, III
7,437,755	B2	10/2008	William

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2606326	11/2006
DE	19882328	5/2014

(Continued)

OTHER PUBLICATIONS

Ori Jacobovitz. "Blockchain for identity management." The Lynne and William Frankel Center for Computer Science Department of Computer Science. Dec. 2016 (Dec. 2016) Retrieved on May 27, 2019 from https://www.cs.bgu.ac.il/~frankel/TechnicalReports/2016/16-02.pdf.

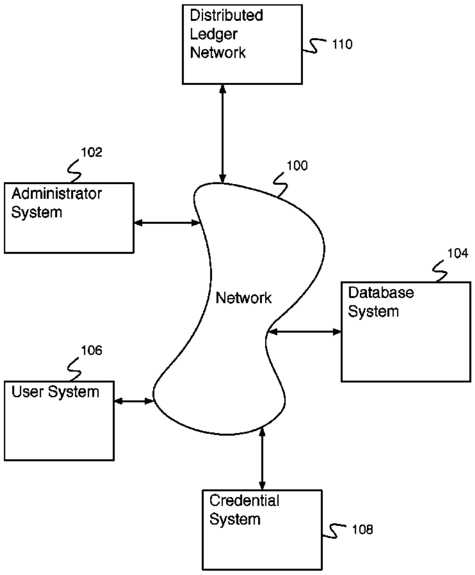
(Continued)

Primary Examiner — Trong H Nguyen
Assistant Examiner — Michael M Lee
(74) *Attorney, Agent, or Firm* — Van Pelt, Yi & James LLP

(57) **ABSTRACT**

A system for providing an application includes an interface and a processor. The interface is configured to receive an indication to provide an application to a device. The processor is configured to provide the application to the device. The application is configured to: receive a request for a list of valid credentials; determine a list of stored credentials; provide the list of stored credentials to a database system; receive an indication of revoked credentials from the database system; and determine the list of valid credentials based at least in part on the list of stored credentials and the revoked credentials.

11 Claims, 13 Drawing Sheets



(51) **Int. Cl.**

H04L 9/32	(2006.01)
G06F 21/45	(2013.01)
G06F 21/31	(2013.01)
G06F 16/27	(2019.01)
G06F 21/60	(2013.01)
G06Q 10/10	(2012.01)
H04L 9/08	(2006.01)
G06F 21/62	(2013.01)

(52) **U.S. Cl.**

CPC ***G06F 21/604*** (2013.01); ***G06Q 10/105*** (2013.01); ***H04L 9/0819*** (2013.01); ***H04L 9/0891*** (2013.01); ***H04L 9/3213*** (2013.01); ***H04L 9/3226*** (2013.01); ***H04L 9/3247*** (2013.01); ***H04L 63/0428*** (2013.01); *G06F 21/6245* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,735,120	B2	6/2010	Wallace	
8,719,952	B1	5/2014	Damm-Goossens	
8,745,718	B1	6/2014	Dufel	
9,374,368	B1	6/2016	Roth	
9,419,968	B1	8/2016	Pei	
9,485,096	B2	11/2016	Shrivastava	
9,490,984	B2	11/2016	Leicher	
9,672,538	B1	6/2017	Vaynblat	
9,749,140	B2	8/2017	Oberhauser	
10,360,363	B1	7/2019	Grosberg	
10,460,313	B1	10/2019	Clark	
2002/0176583	A1	11/2002	Buttiker	
2004/0162985	A1*	8/2004	Freeman	H04L 9/3247 713/176
2004/0177276	A1	9/2004	MacKinnon	
2006/0200856	A1	9/2006	Salowey	
2008/0148373	A1	6/2008	Adams	
2008/0301553	A1	12/2008	Basu	
2009/0119756	A1	5/2009	Acuna	
2011/0113484	A1	5/2011	Zeuthen	
2012/0079570	A1	3/2012	Fu	
2013/0030989	A1	1/2013	Geller	
2013/0125231	A1	5/2013	Kuenzi	
2014/0002236	A1	1/2014	Pineau	
2014/0079221	A1	3/2014	McCallum	
2014/0096213	A1*	4/2014	Quan	G06F 21/606 726/7
2014/0181927	A1*	6/2014	Sarkissian	G06Q 30/0251 726/6
2014/0187149	A1	7/2014	Lortz	
2014/0222682	A1	8/2014	Dua	
2014/0281525	A1	9/2014	Acar	
2014/0373117	A1*	12/2014	Le Saint	H04L 9/3066 726/6
2015/0089244	A1	3/2015	Roth	
2015/0278500	A1	10/2015	Burch	
2015/0278824	A1	10/2015	Zabar	
2015/0288694	A1	10/2015	Liebl, III	
2015/0350913	A1*	12/2015	Eberwine	G07C 9/00571 455/411
2016/0149896	A1	5/2016	Sarkissian	
2016/0162896	A1	6/2016	Grigg	
2016/0255079	A1*	9/2016	Harrison	H04L 63/0876 713/2
2016/0330027	A1	11/2016	Ebrahimi	
2017/0005804	A1	1/2017	Zinder	
2017/0005809	A1*	1/2017	Adam	G06Q 10/10
2017/0012784	A1	1/2017	Cross	
2017/0041151	A1	2/2017	Kommireddy	
2017/0109759	A1	4/2017	Korb	
2017/0126661	A1	5/2017	Brannon	
2017/0155626	A1*	6/2017	Li	H04L 63/0442
2017/0155686	A1	6/2017	Yanacek	
2017/0180128	A1	6/2017	Lu	
2017/0222814	A1	8/2017	Oberhauser	
2017/0250972	A1	8/2017	Ronda	
2017/0257358	A1	9/2017	Ebrahimi	
2017/0277773	A1	9/2017	Iasi	
2017/0302659	A1	10/2017	Shteingart	
2017/0317997	A1	11/2017	Smith	
2017/0338967	A1*	11/2017	Lewison	H04L 9/321
2017/0372055	A1	12/2017	Robinson	
2018/0075247	A1*	3/2018	Campero	G07C 9/28
2018/0124041	A1	5/2018	Bhalerao	
2018/0144563	A1	5/2018	Reymann	
2018/0159839	A1*	6/2018	Citron	H04L 63/0853
2018/0167394	A1	6/2018	High	
2018/0248859	A1	8/2018	Zudic	
2019/0036710	A1*	1/2019	Qiu	H04L 9/3239
2019/0164156	A1	5/2019	Lindemann	
2019/0230073	A1	7/2019	Patel	
2019/0230092	A1	7/2019	Patel	
2019/0363889	A1	11/2019	Wang	
2020/0145219	A1	5/2020	Sebastian	

FOREIGN PATENT DOCUMENTS

WO	2010083522	7/2010
WO	2017085546	5/2017
WO	2017127564	7/2017

OTHER PUBLICATIONS

Andrew Tobin, “Sovrin: What Goes on the Ledger”, white paper, Apr. 2017.

Reed et al.,: “Decentralized Identifiers (DIDs) v0.9”, Feb. 12, 2018 (Feb. 12, 2018), XP055855370, Retrieved from the Internet: URL: https://web.archive.org/web/20180212212114/https://w3c-ccg.github.io/did-spec/#proof-optional [retrieved on Oct. 27, 2021].

The Sovrin Foundation, “Sovrin™: A Protocol and Token for SelfSovereign Identity and Decentralized Trust”, white paper, Jan. 2018.

Windley et al.: “Sovrin (TM): A Protocol and Token for Self-Sovereign Identity and Decentralized Trust A White Paper from the Sovrin Foundation”, White Paper, Jan. 1, 2018 (Jan. 1, 2018), pp. 1-42, XP055648450, US, Retrieved from the Internet: URL: https://sovrin.org/wp-content/uploads/Sovrin-Protocol-and-Token-White-Paper.pdf [retrieved on Dec. 2, 2019].

* cited by examiner

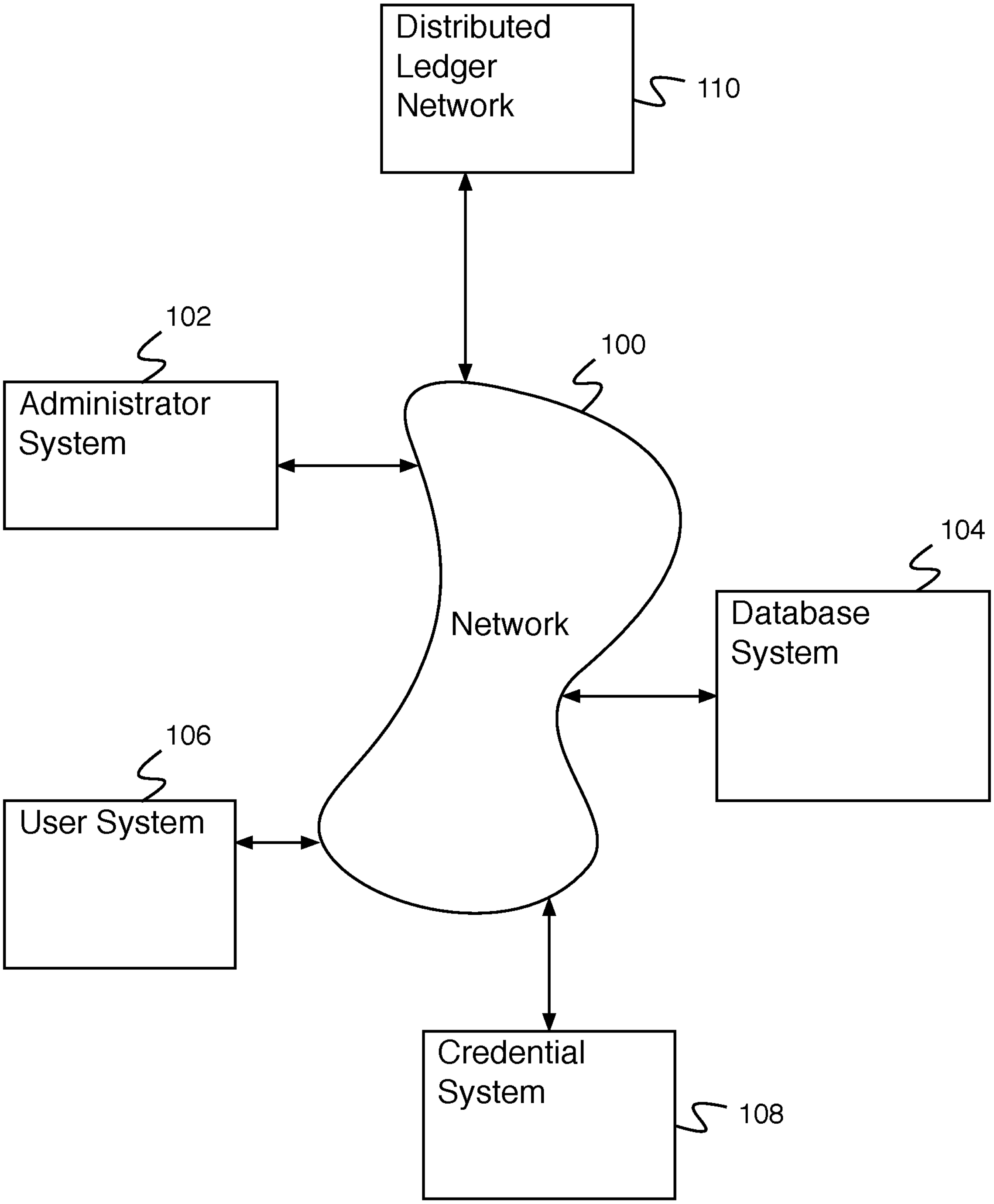

Distributed Ledger Network
110
102
Administrator System
100
Network
104
Database System
106
User System
Credential System
108

Fig. 1

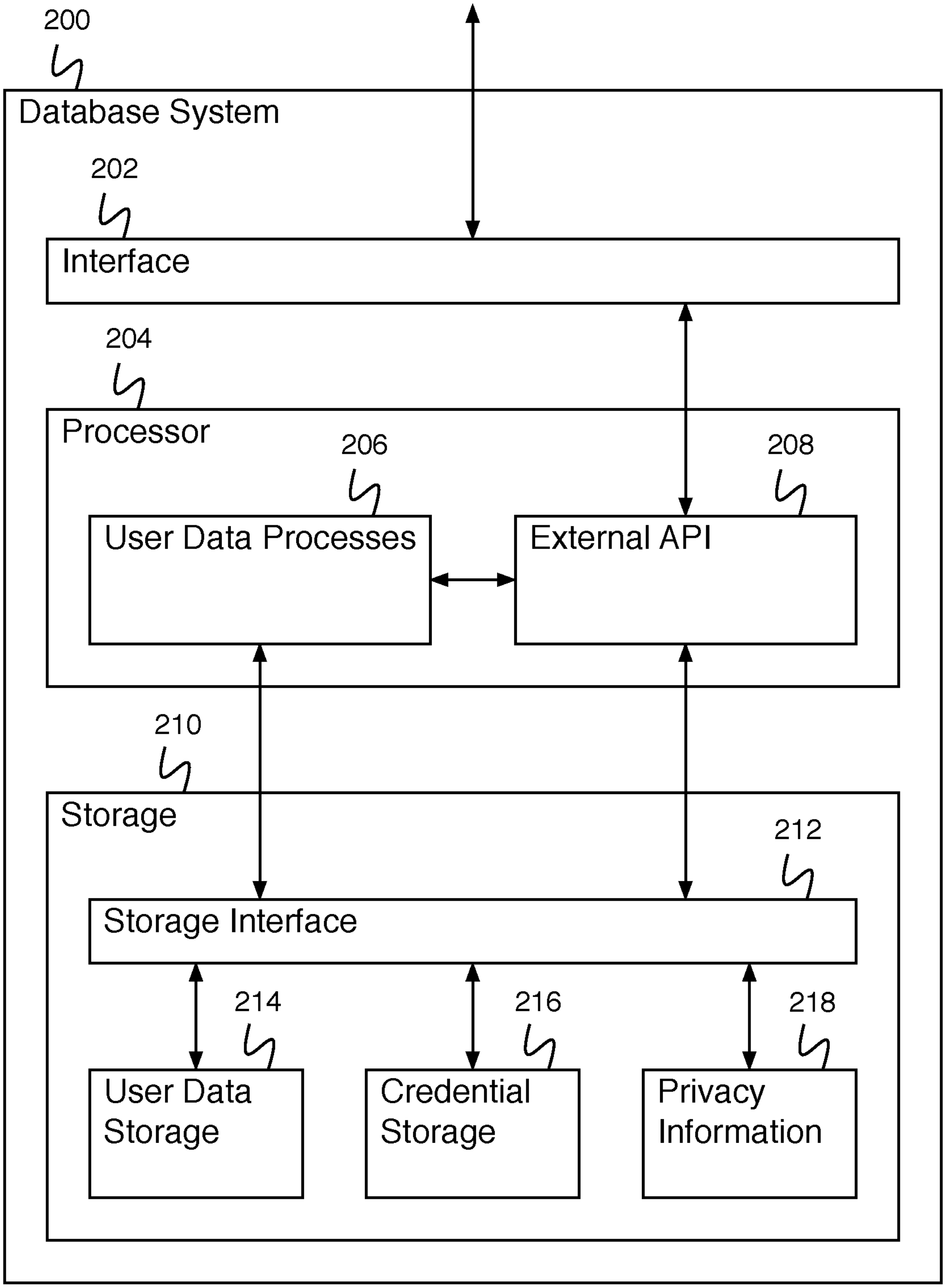

200
Database System
202
Interface
204
Processor
206
User Data Processes
208
External API
210
Storage
212
Storage Interface
214
216
218
User Data Storage
Credential Storage
Privacy Information

Fig. 2

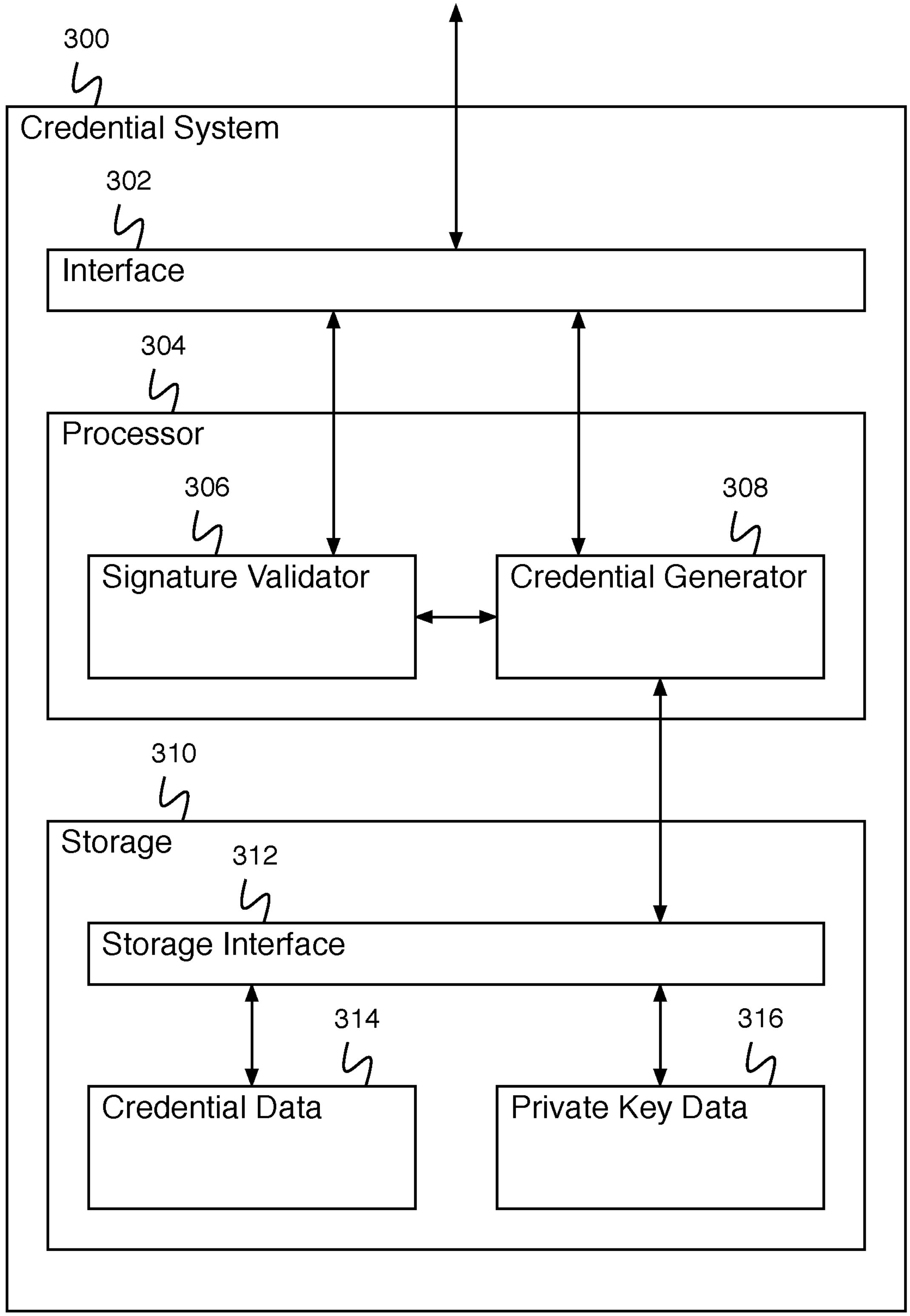

300
Credential System
302
Interface
304
Processor
306
Signature Validator
308
Credential Generator
310
Storage
312
Storage Interface
314
316
Credential Data
Private Key Data

Fig. 3

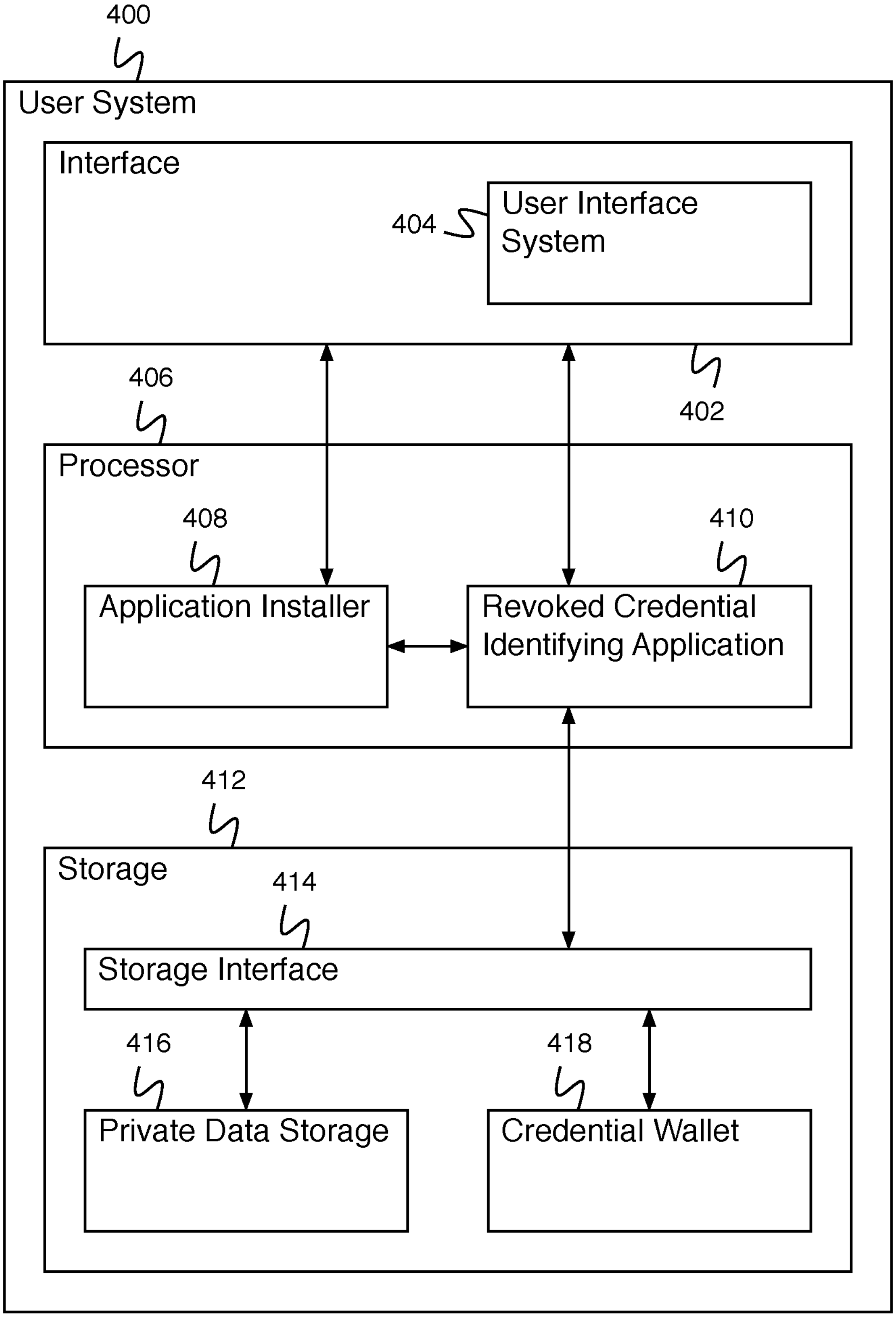

400
User System
Interface
404
User Interface System
406
402
Processor
408
410
Application Installer
Revoked Credential Identifying Application
412
Storage
414
Storage Interface
416
418
Private Data Storage
Credential Wallet

Fig. 4

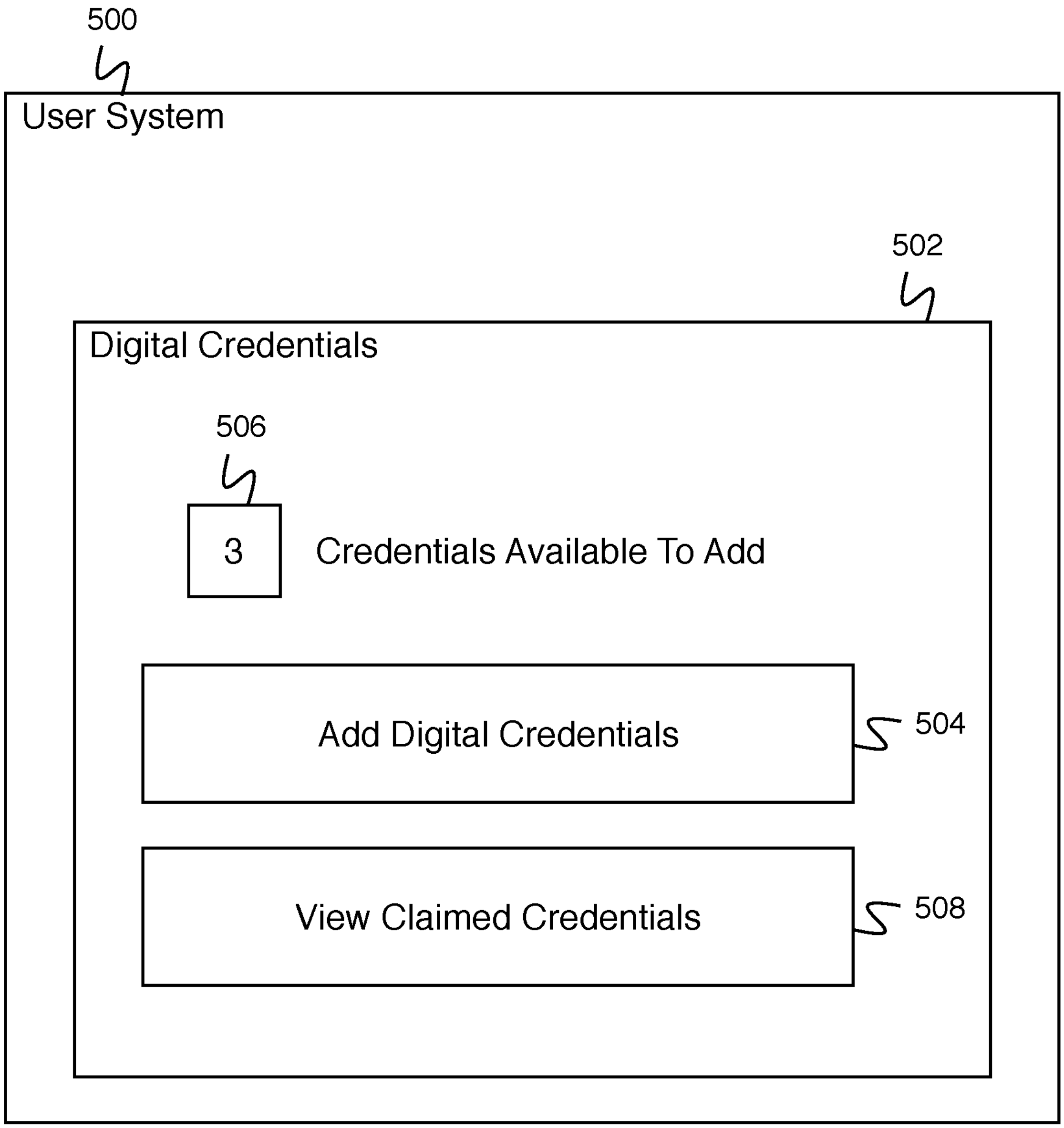

500
User System
502
Digital Credentials
506
3
Credentials Available To Add
Add Digital Credentials
504
View Claimed Credentials
508

Fig. 5A

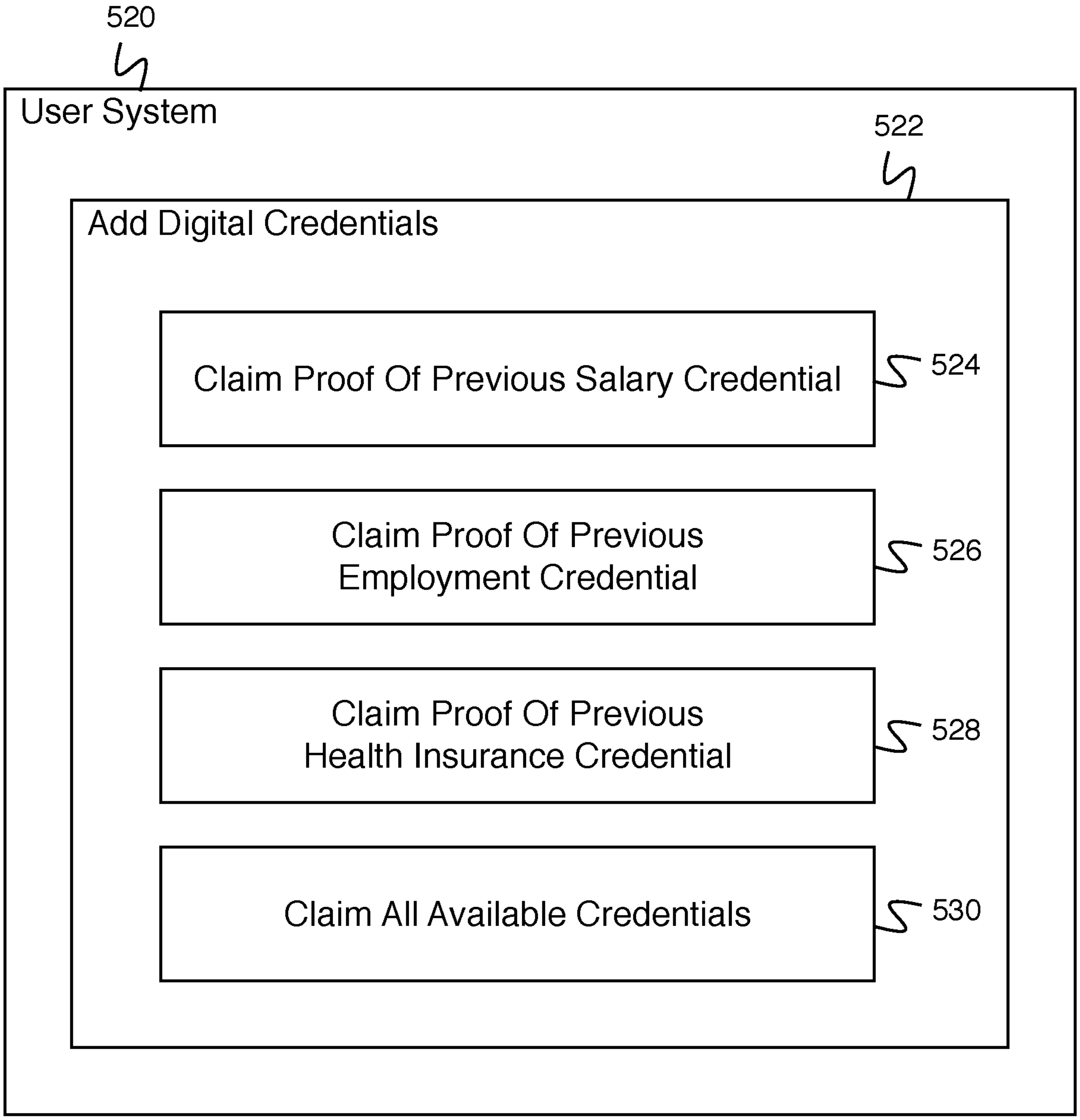

520
User System
522
Add Digital Credentials
Claim Proof Of Previous Salary Credential
524
Claim Proof Of Previous Employment Credential
526
Claim Proof Of Previous Health Insurance Credential
528
Claim All Available Credentials
530

Fig. 5B

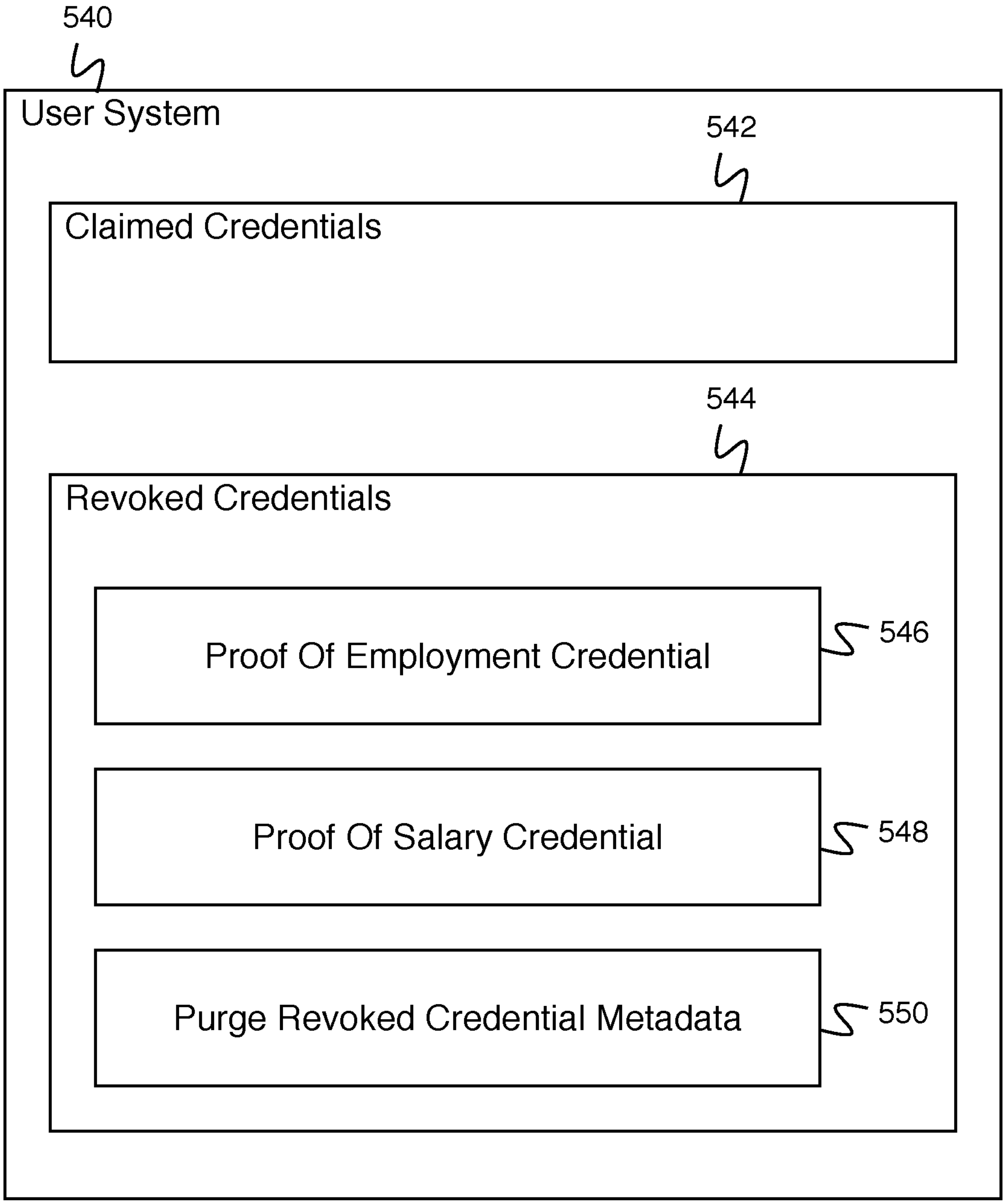

540
User System
542
Claimed Credentials
544
Revoked Credentials
Proof Of Employment Credential
546
Proof Of Salary Credential
548
Purge Revoked Credential Metadata
550

Fig. 5C

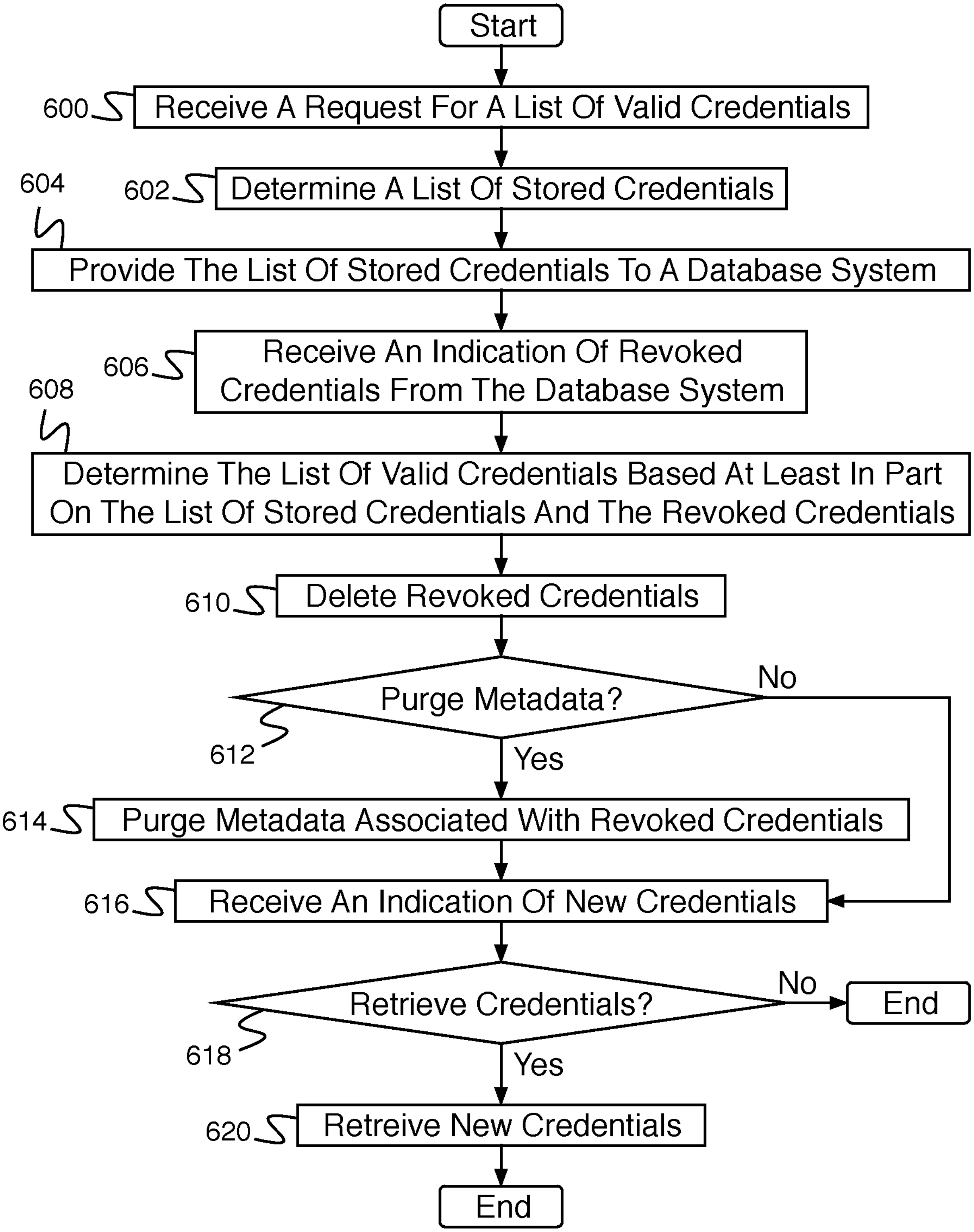

Start
600
Receive A Request For A List Of Valid Credentials
602
Determine A List Of Stored Credentials
604
Provide The List Of Stored Credentials To A Database System
606
Receive An Indication Of Revoked Credentials From The Database System
608
Determine The List Of Valid Credentials Based At Least In Part On The List Of Stored Credentials And The Revoked Credentials
610
Delete Revoked Credentials
Purge Metadata?
No
612
Yes
614
Purge Metadata Associated With Revoked Credentials
616
Receive An Indication Of New Credentials
Retrieve Credentials?
No
End
618
Yes
620
Retreive New Credentials
End

Fig. 6

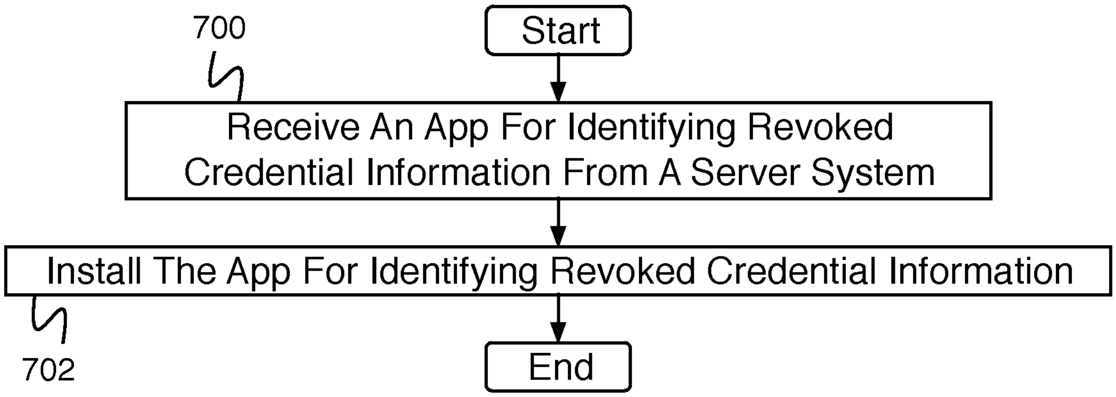

700
Start
Receive An App For Identifying Revoked Credential Information From A Server System
Install The App For Identifying Revoked Credential Information
702
End

Fig. 7

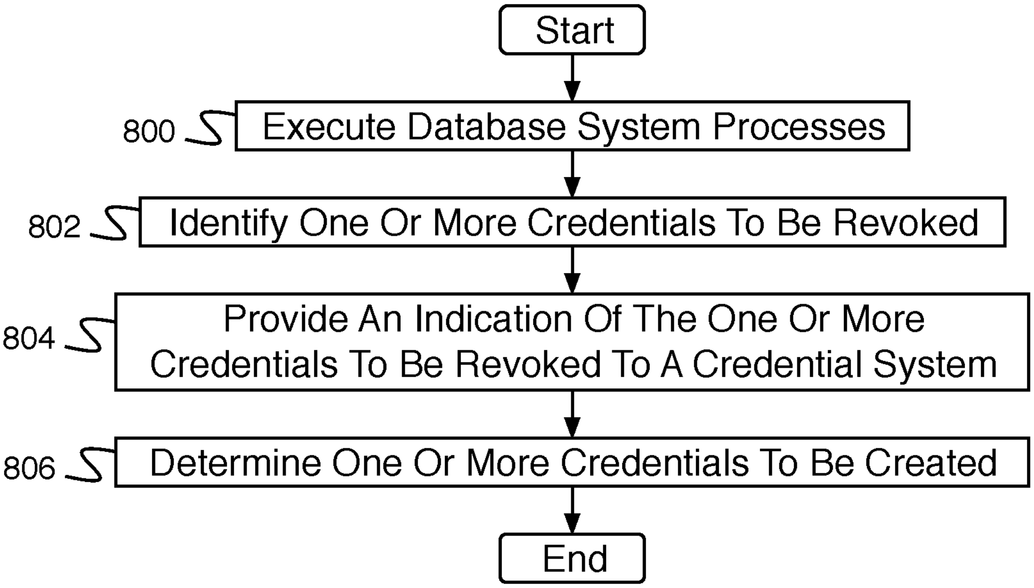

Start
800
Execute Database System Processes
802
Identify One Or More Credentials To Be Revoked
804
Provide An Indication Of The One Or More Credentials To Be Revoked To A Credential System
806
Determine One Or More Credentials To Be Created
End

Fig. 8

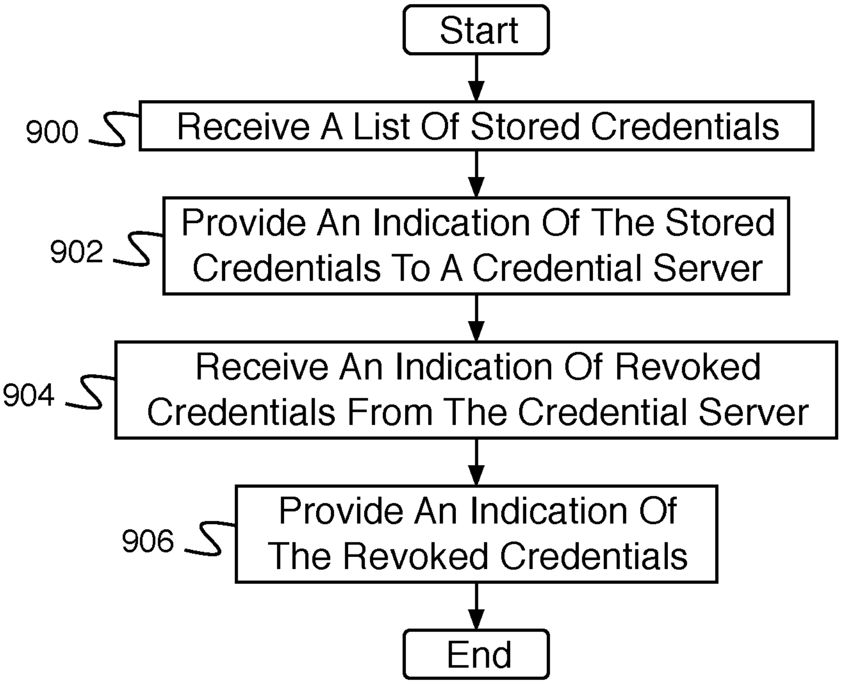

Start
900
Receive A List Of Stored Credentials
902
Provide An Indication Of The Stored Credentials To A Credential Server
904
Receive An Indication Of Revoked Credentials From The Credential Server
906
Provide An Indication Of The Revoked Credentials
End

Fig. 9

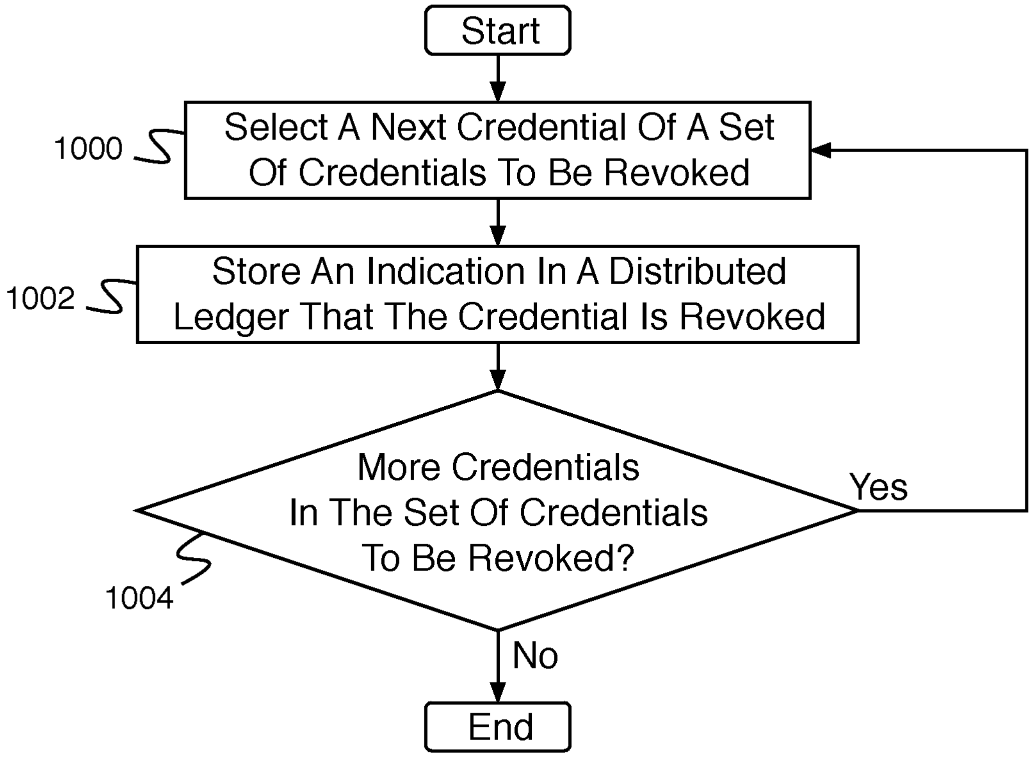

Start
1000
Select A Next Credential Of A Set Of Credentials To Be Revoked
1002
Store An Indication In A Distributed Ledger That The Credential Is Revoked
1004
More Credentials In The Set Of Credentials To Be Revoked?
Yes
No
End

Fig. 10

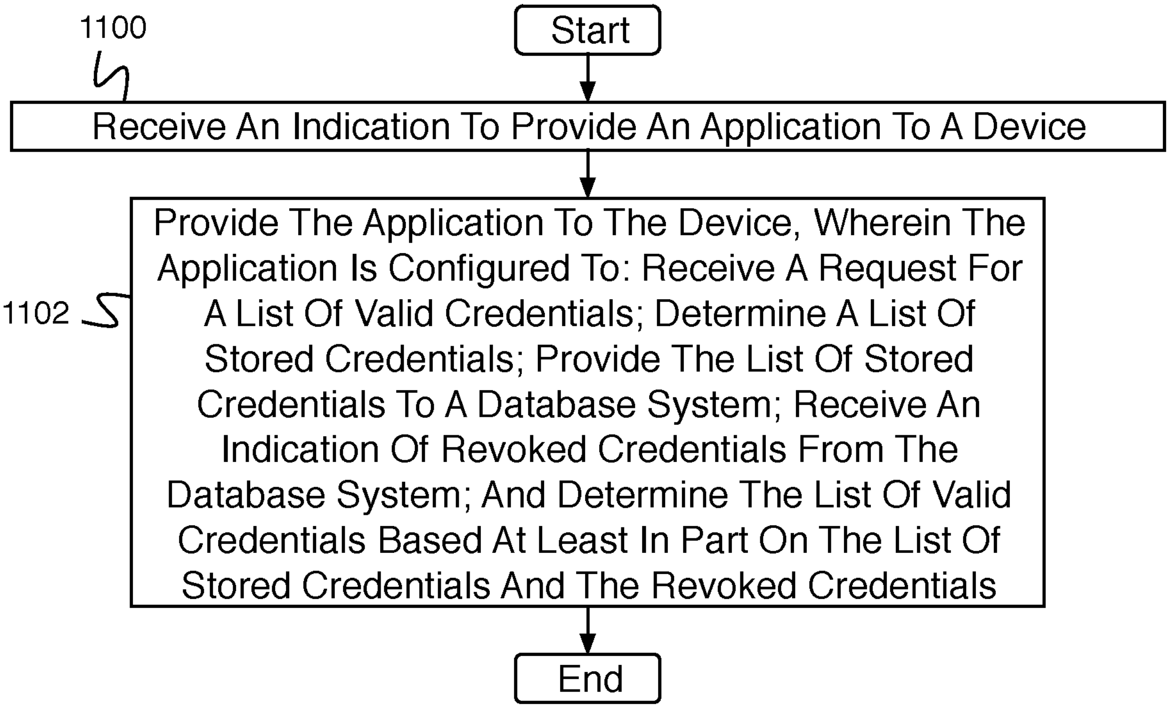

1100
Start
Receive An Indication To Provide An Application To A Device
1102
Provide The Application To The Device, Wherein The Application Is Configured To: Receive A Request For A List Of Valid Credentials; Determine A List Of Stored Credentials; Provide The List Of Stored Credentials To A Database System; Receive An Indication Of Revoked Credentials From The Database System; And Determine The List Of Valid Credentials Based At Least In Part On The List Of Stored Credentials And The Revoked Credentials
End

Fig. 11

IDENTIFYING REVOKED CREDENTIALS

CROSS REFERENCE TO OTHER APPLICATIONS

This application claims priority to U.S. Provisional Patent Application No. 62/648,854 entitled SYSTEM FOR ISSUANCE, VERIFICATION, AND REVOCATION OF CREDENTIALS filed Mar. 27, 2018 which is incorporated herein by reference for all purposes.

BACKGROUND OF THE INVENTION

Modern users of database systems (e.g., human resources database systems or financial database systems) rely on the database systems for access to their personal information or verification (e.g., salary, tax details, employment status, etc. or university degree, certifications, criminal record, ownership, etc.). Users trust the database systems to contain correct information. When a user desires to provide personal information or verification information from the database system to another database system (e.g., providing previous employment or salary information to a potential employer, providing previous insurance information to a potential employer), the user typically accesses the information on the database system and then provides the information manually to the other database system (e.g., by inputting data into an electronic form or uploading digital paperwork). The user trusts the information it receives from the database system, however the other database system cannot have the same level of trust in the information it receives from the user. There is a problem wherein it is difficult to trust data as it passes from system to system via a human.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the invention are disclosed in the following detailed description and the accompanying drawings.

FIG. **1** is a block diagram illustrating an embodiment of a network system.

FIG. **2** is a block diagram illustrating an embodiment of a database system.

FIG. **3** is a block diagram illustrating an embodiment of a credential system.

FIG. **4** is a block diagram illustrating an embodiment of a user system.

FIG. **5**A is a diagram illustrating an embodiment of a user interface for a user system.

FIG. **5**B is a diagram illustrating an embodiment of a user interface for a user system.

FIG. **5**C is a diagram illustrating an embodiment of a user interface for a user system.

FIG. **6** is a flow diagram illustrating an embodiment of a process for identifying revoked credential information.

FIG. **7** is a flow diagram illustrating an embodiment of a process for installing an app.

FIG. **8** is a flow diagram illustrating an embodiment of a process for a credential revoking database system process.

FIG. **9** is a flow diagram illustrating an embodiment of a process for a determining revoked credentials.

FIG. **10** is a flow diagram illustrating an embodiment of a process for revoking credentials.

FIG. **11** is a flow diagram illustrating an embodiment of a process for providing an application.

DETAILED DESCRIPTION

The invention can be implemented in numerous ways, including as a process; an apparatus; a system; a composition of matter; a computer program product embodied on a computer readable storage medium; and/or a processor, such as a processor configured to execute instructions stored on and/or provided by a memory coupled to the processor. In this specification, these implementations, or any other form that the invention may take, may be referred to as techniques. In general, the order of the steps of disclosed processes may be altered within the scope of the invention. Unless stated otherwise, a component such as a processor or a memory described as being configured to perform a task may be implemented as a general component that is temporarily configured to perform the task at a given time or a specific component that is manufactured to perform the task. As used herein, the term 'processor' refers to one or more devices, circuits, and/or processing cores configured to process data, such as computer program instructions.

A detailed description of one or more embodiments of the invention is provided below along with accompanying figures that illustrate the principles of the invention. The invention is described in connection with such embodiments, but the invention is not limited to any embodiment. The scope of the invention is limited only by the claims and the invention encompasses numerous alternatives, modifications and equivalents. Numerous specific details are set forth in the following description in order to provide a thorough understanding of the invention. These details are provided for the purpose of example and the invention may be practiced according to the claims without some or all of these specific details. For the purpose of clarity, technical material that is known in the technical fields related to the invention has not been described in detail so that the invention is not unnecessarily obscured.

A system for providing an application comprises an interface configured to receive an indication to provide an application to a device, and a processor configured to provide the application to the device. The application is configured to receive a request for a list of valid credentials, determine a list of stored credentials, provide the list of stored credentials to a database system, receive an indication of revoked credentials from the database system, and determine the list of valid credentials based at least in part on the list of stored credentials and the revoked credentials.

A system for identifying revoked credential information comprises an interface configured to receive a request for a list of valid credentials, and a processor configured to determine a list of stored credentials, provide the list of stored credentials to a database system, receive an indication of revoked credentials from the database system, and determine the list of valid credentials based at least in part on the list of stored credentials and the revoked credentials.

A system for sharing credentials comprises a system for a user system (e.g., a computing system for use by a user) interacting with a database system. The database system further interacts with a credential issuing system. The database system stores user information for the user. The database system further determines a set of credentials available to the user based on the user information as well as record of previously issued credentials. The credentials comprise categories satisfied by the user information at differing levels of specificity. For example, in the case where the user comprises an employee earning $95,000 per year, the database system could determine credentials available to the user indicating that the user earns more than $60,000 per year, that the user earns more than $80,000 per year, that the user earns in the range of $90,000-$100,000 per year, etc. When the user interacts with the database system using a credential app, the database system determines the set of credentials available to the user and provides the list of credentials to the credential app or application. The user can then request that one or more available credentials be downloaded to local storage using the credential app. When the user interacts with another system requesting personal information or verification information, a stored credential can be used to provide proof of the requested information.

When a user accesses a credential app, the credential app determines a list of stored credentials available to the user as proof of information. The credential app determines a list of stored credentials and checks their validity by providing the list to the database system. The database system queries a credential system, which determines whether a revocation indication has been written to a distributed ledger network for each of the stored credentials. Any revoked credentials of the stored credentials are determined by the credential system, and an indication of the revoked credentials is provided to the database system. The credential server revokes the credential in such a way that its validity is publicly verifiable (e.g., cryptographic keys used for verification can be found in a public or semi-public distributed ledger system). The database system then provides an indication of the revoked credentials to the user system. The user system deletes stored credential information associated with the revoked credentials. Metadata associated with the credentials is stored in order to enable a display that the credentials were revoked, and is purged when the user desires.

By enabling the transfer of personal information or verification information (e.g., salary, tax details, employment status, etc. or university degree, certifications, criminal record, ownership, etc.) between disparate database systems using authenticated credentials, this system allows that transfer of information with a level of trust and security not previously accomplished. This allows the reduction or elimination of problems such as data theft during information transfer and misrepresentation of personal information or verification information.

The system is a better computer system enabling efficient secure distribution of information. For example, the system is set up to securely receive and provide information. The security protocols and the distributed ledger storage enable credentialing data and being able to act as a trusted source for the data.

In some embodiments, a technology other than a secure distributed ledger is used for securely storing public keys that enable the verifiability of data. In some embodiments, a shared accessible network accessible medium is used to distribute public keys associated with the verifiability of authenticated credentials. This shared public network could be an open model like Twitter where users tweet the public key information (keybase.io does this), or a semi-private shared database of public keys for which the participants in the credentials exchanges all have authenticated access via a set of RESTful APIs to fetch keys for credential verification.

FIG. **1** is a block diagram illustrating an embodiment of a network system. In some embodiments, the network system of FIG. **1** comprises a network system for a system for validating data. In the example shown, FIG. **1** comprises network **100**. In various embodiments, network **100** comprises one or more of the following: a local area network, a wide area network, a wired network, a wireless network, the Internet, an intranet, a storage area network, or any other appropriate communication network. Administrator system **102**, database system **104**, user system **106**, credential system **108**, and distributed ledger network **110** communicate via network **100**. Administrator system **102** comprises an administrator system for use by an administrator. Administrator system **102** comprises an administrator system for executing administrator commands, for configuring database system **104**, etc. Database system **104** comprises a database system for providing user access to data stored in a tenanted area of database system **104** (e.g., access to add data, view data, modify data, delete data, access reports, execute business processes, etc.). Database system **104** additionally comprises a system for providing a credential to a user. The credential comprises a digital token that may be provided to a different database system securely indicating user data. Credential system **108** comprises a system for creating a credential and providing the credential to database system **104**. Credential system **108** writes credential information to distributed ledger network **110** when a credential is created. Database system **104** additionally comprises a system for determining to revoke a credential. Credential system **108** receives an indication from database system **104** to revoke a credential and writes revocation information to distributed ledger network **110** to revoke the credential. Database system **104** additionally comprises a system for determining whether a credential has been revoked. Credential system **108** receives an indication from database system **104** to determine whether a credential has been revoked and queries distributed ledger network **110** to determine whether revocation information associated with the credential has been written.

User system **106** comprises a user system for use by a user. A user uses a user system to interact with database system **104**, for example to store database data, to request database data, to request reporting based on database data, to request a credential based on database data, etc. In some embodiments, the network system of FIG. **1** comprises a plurality of user systems associated with one or more users. A user uses a user system to provide an indication to database system **104** requesting a credential (e.g., a credential based on data stored by database system **104**).

User system **106** receives login information associated with a user, determines credentials available to the user, and provides an indication of the credentials available to the user. Determining credentials available to the user comprises identifying revoked credential information. User system **106** is configured to receive a request for a list of valid credentials; determine a list of stored credentials; provide the list of stored credentials to a database system; receive an indication of revoked credentials from the database system; and determine the list of valid credentials based at least in part on the list of stored credentials and the revoked credentials.

User system **106** then receives an indication to add a credential (e.g., one of the credentials available to the user), creates a credential request, and provides the credential request to a server system (e.g., database system **104**). User system **106** then receives and stores the credential. Upon receive the credential request, database system **104** verifies that the user has access to the credential (e.g., that the credential is valid for the user) and in the event that the user has access to the credential, database system **104** requests the credential from credential system **108**. Database system **104** receives the credential from credential system **108** and provides it to user system **106**.

FIG. **2** is a block diagram illustrating an embodiment of a database system. In some embodiments, database system **200** comprises database system **104** of FIG. **1**. In the example shown, database system **200** comprises interface **202**, processor **204**, and storage **210**. Interface **202** comprises an interface for communicating with processor **204** and with an external network (e.g., network **100** of FIG. **1**, for communication with an administrator system, a user system, a credential system, etc.). Processor **204** comprises a processor for processing data, performing computations, controlling communications, etc. Processor **204** comprises external API (e.g., application programming interface) **208** for interacting with external systems, allowing external systems to request processor **204** perform actions, etc. User data processes **206** comprises a set of processes for manipulating (e.g., reading, writing, modifying, deleting, etc.) user data (e.g., user data stored in user data storage **214**) and credentials (e.g., credentials stored in credential storage **216**). User data processes **206** and external API **208** communicate with data stored in storage **210** via storage interface **212**. User data storage **214** comprises user data describing users associated with database system **200**. Credential storage **216** comprises credentials accessed by database system **200**. Privacy information **218** comprises privacy information associated with credentials stored by credential storage **216**.

Database system **200** receives a request from a user system for an indication of revoked credentials based on a list of credentials. Database system **200** receives the list of credentials and provides a credential identifier associated with each credential to a credential system. Database system **200** then receives an indication of whether the credential was revoked for each credential. Database system **200** provides the user system an indication of revoked credentials.

Database system **200** receives a request for a credential associated with a user (e.g., a user for the credential) and associated with a credential identifier (e.g., a credential identifier identifying the requested credential). Database system **200** then determines that the credential identifier is valid for the user (e.g., that the user is entitled to the indicated credential), determines privacy information associated with the requested credential, and provides the credential request to a credential server. Database system **200** receives the credential from the credential server and provides the credential, the privacy information, and the credential identifier (e.g., to the requesting user system). In some embodiments, privacy information is stored as metadata.

FIG. **3** is a block diagram illustrating an embodiment of a credential system. In some embodiments, credential system **300** comprises credential system **108** of FIG. **1**. In the example shown, credential system **300** comprises interface **302**, processor **304**, and storage **310**. Interface **302** comprises an interface for communicating with processor **304** and with an external network (e.g., network **100** of FIG. **1**, for communication with an administrator system, a user system, a database system, etc.). Processor **304** comprises a processor for processing data, performing computations, controlling communications, etc. Processor **304** comprises signature validator **306** and credential generator **308**. Signature validator **306** comprises a signature validator for validating a digital signature (e.g., a signature received as part of a credential request). Credential generator **308** comprises a credential generator for generating a credential (e.g., a credential generator for generating a credential based at least in part on a private key, a credential generator for cryptographically generating a credential, etc.). Credential generator **308** interacts with credential data **314** and private key data of storage **310** via storage interface **312**.

Credential system **300** comprises a system for determining whether a credential has been revoked. Credential system **300** receives a credential identifier or a set of credential identifiers from a database system and determines whether the associated credential or credentials has been revoked. Credential system **300** determines whether a credential has been revoked by looking up a credential identifier in a distributed ledger network. After determining validity for each received credential identifier, credential system **300** provides an indication of revoked credentials to a database system.

Credential system **300** additionally comprises a system for revoking a set of credentials. Credential system **300** receives an indication to revoke a set of credentials including a set of credential identifiers. For each credential identifier of the set of credential identifiers, credential system **300** stores an indication in a distributed ledger that the credential associated with the credential identifier is revoked.

FIG. **4** is a block diagram illustrating an embodiment of a user system. In some embodiments, user system **400** of FIG. **4** comprises user system **106** of FIG. **1**. In various embodiments, user system **400** comprises a personal computer, a mobile device, a tablet computer, etc. In the example shown, user system **400** comprises interface **402**, processor **406**, and storage **412**. Interface **402** comprises an interface for communicating with processor **406** and with an external network (e.g., network **100** of FIG. **1**, for communication with an administrator system, a database system, a credential system, etc.). Interface **402** additionally comprises user interface system for providing a user interface for interacting with a user. Processor **406** comprises a processor for processing data, performing computations, controlling communications, etc. Processor **406** comprises application installer **408** and revoked credential identifying application **410**. Application installer **408** comprises an application installer for receiving an application from an external server and installing the application on user system **400**. For example, revoked credential identifying application **410** is installed by application installer **408**. Any other appropriate applications are additionally installed by application installer **408**. Revoked credential identifying application **410** comprises an application for interacting with a database system to request a credential. Revoked credential identifying application **410** interacts with private data storage **416** and credential wallet **418** of storage **412** via storage interface **414**.

Revoked credential identifying application **410** receives a request for a list of valid credentials (e.g., a part of a process for displaying valid credentials to a user). Revoked credential identifying application **410** then determines a list of stored credentials (e.g., stored in credential wallet **418**), provides the list of stored credentials to a database system, receives an indication of revoked credentials from the database system, and determines the list of valid credentials based at least in part on the list of stored credentials and the revoked credentials.

FIG. **5**A is a diagram illustrating an embodiment of a user interface for a user system. In some embodiments, the user interface of FIG. **5**A comprises a user interface provided by user interface system **404** of FIG. **4**. In the example shown, user system **500** displays digital credentials window **502**. Digital credentials window **502** displays add credentials button **504** and view claimed credentials button **508**. Add credentials button **504** comprises number of available credentials button **506**. Number of available credentials button **506** is updated with a current number of available credentials—for example, a current number of available credentials is updated on a schedule, each time a user accesses digital credentials window **502**, etc. User system **500** updates number of available credentials button **506** by querying a server using user identifying information for the number of available credentials. In the event the user makes an indication to add credentials button **504**, the user is provided a list of available credentials to add. In the event the user makes an indication to view claimed credentials button **508**, the user is provided a list of claimed credentials for viewing. Determining a list of claimed credentials comprises determining whether any claimed credentials have been revoked.

FIG. **5**B is a diagram illustrating an embodiment of a user interface for a user system. In some embodiments, the user interface of FIG. **5**B comprises a user interface provided by user interface system **404** of FIG. **4**. In the example shown, user system **520** displays add digital credentials window **522**. For example, add digital credentials window **522** is shown in response to an indication to an add digital credentials button (e.g., add digital credentials button **504** of FIG. **5**A). In the example shown, add digital credentials window **522** displays claim proof of salary credential button **524**, claim proof of employment credential button **526**, claim proof of health insurance credential button **528**, and claim all available credentials button **530**. In the event the user makes an indication to a button, a process is started to claim the appropriate credential or credentials.

FIG. **5**C is a diagram illustrating an embodiment of a user interface for a user system. In some embodiments, the user interface of FIG. **5**C comprises a user interface provided by user interface system **404** of FIG. **4**. In the example shown, user system **540** displays claimed credentials window **542** and revoked credentials window **544**. For example, claimed credentials window **542** and revoked credentials window **544** are shown in response to an indication to a view claimed credentials button (e.g., view claimed credentials button **508** of FIG. **5**A). Claimed credentials window **542** displays no claimed credentials. Revoked credentials window **544** displays proof of employment credential **546** and proof of salary credential **548**. Showing proof of employment credential **546** and proof of salary credential **548** in revoked credentials window **544** comprises an indication that proof of employment credential **546** and proof of salary credential **548** have been revoked and can no longer be used. Credential data associated with proof of employment credential **546** and proof of salary credential **548** is deleted. Metadata associated with proof of employment credential **546** and proof of salary credential **548** is stored (e.g., to allow an indication of proof of employment credential **546** and proof of salary credential **548** to be shown in revoked credentials window **544**). Revoked credentials window **544** additionally comprises purge revoked credential metadata button **550**. When an indication to purge revoked credential metadata button **550** is received, metadata associated with proof of employment credential **546** and proof of salary credential **548** is deleted.

FIG. **6** is a flow diagram illustrating an embodiment of a process for identifying revoked credential information. In some embodiments, the process of FIG. **6** is executed by a user system (e.g., user system **106** of FIG. **1**). In the example shown, in **600**, a request for a list of valid credentials is received. In **602** a list of stored credentials is received. In **604**, the list of stored credentials is provided to a database system. In **606**, an indication of revoked credentials is received from the database system. In **608**, the list of valid credentials is determined based at least in part on the list of stored credentials and the revoked credentials. For example, the credentials available are available based upon a user identity (e.g., who the user is), what the credentialing service knows it has already given the user, credentials previously known to be revoked, or any other appropriate credential. In **610**, revoked credentials are deleted. In **612**, it is determined whether to purge metadata. In some embodiments, it is determined to purge metadata in the event that an indication to a purge revoked credential metadata button is received. In the event it is determined not to purge metadata, control passes to **616**. In the event it is determined to purge metadata, control passes to **614**. In **614**, metadata associated with revoked credentials is purged. In **616** an indication of new credentials is received. For example, new credentials comprise new credentials generated as a byproduct of revoking credentials. In **618**, it is determined whether to retrieve credentials (e.g., the new credentials). In some embodiments, it is determined to retrieve credentials in the event that an indication to a claim credential button is received. In the event it is determined not to retrieve credentials, the process ends. In the event it is determined to retrieve credentials, control passes to **620**. In **620**, new credentials are retrieved.

FIG. **7** is a flow diagram illustrating an embodiment of a process for installing an app. In some embodiments, the process of FIG. **7** is executed by application installer **408**. In the example shown, in **700**, an app for identifying revoked credential information is received from a server system. In **702**, the app for identifying revoked credential information is installed.

FIG. **8** is a flow diagram illustrating an embodiment of a process for a credential revoking database system process. In some embodiments, the process of FIG. **8** is executed by a database system (e.g., database system **104** of FIG. **1**). For example, the process of FIG. **8** comprises a process of user data processes **206** of FIG. **2**. In the example shown, in **800**, database system processes are executed. For example, processes are executed for creating data, deleting data, modifying data, adding an employee to an employee database, removing an employee from an employee database, etc. In **802**, one or more credentials are identified to be revoked. For example, in the event the process comprises an employee termination process, a credential verifying employment status is revoked. In **804**, an indication of the one or more credentials to be revoked is provided to a credential system. In **806** one or more credentials to be created are determined. For example, in the event the process comprises an employee termination process, a credential verifying a previous employment status is created.

FIG. **9** is a flow diagram illustrating an embodiment of a process for a determining revoked credentials. In some embodiments, the process of FIG. **9** is executed by a database system (e.g., database system **104** of FIG. **1**). For example, the process of FIG. **8** comprises a process of user data processes **206** of FIG. **2**. In the example shown, in **900**, a list of stored credentials is received (e.g., from a user system). In **902**, an indication of the stored credentials is provided to a credential server. In **904**, an indication of revoked credentials is received from the credential server. In **906**, an indication of the revoked credentials is provided.

FIG. **10** is a flow diagram illustrating an embodiment of a process for revoking credentials. In some embodiments, the process of FIG. **10** is executed by a credential system (e.g., credential system **108** of FIG. **1**). For example, the process of FIG. **10** is executed by a credential system in response to an indication of one or more credentials to be revoked. In **1000**, a next credential of a set of credentials to be revoked is selected. In **1002**, an indication is stored in a distributed ledge that the credential is revoked. In **1004**, it is determined whether there are more credentials in the set of credentials to be revoked. In the event it is determined that there are more credentials in the set of credentials to be revoked, control passes to **1000**. In the event it is determined that there are not more credentials in the set of credentials to be revoked, the process ends.

FIG. **11** is a flow diagram illustrating an embodiment of a process for providing an application. In some embodiments, the process of FIG. **11** is executed by database system **104** of FIG. **1**. In the example shown, in **1100**, an indication to provide an application to a device is received. In **1102**, the application is provided to the device, wherein the application is configured to receive a request for a list of valid credentials, determine a list of stored credentials, provide the list of stored credentials to a database system, receive an indication of revoked credentials from the database system, and determine the list of valid credentials based at least in part on the list of stored credentials and the revoked credentials.

Although the foregoing embodiments have been described in some detail for purposes of clarity of understanding, the invention is not limited to the details provided. There are many alternative ways of implementing the invention. The disclosed embodiments are illustrative and not restrictive.

The invention claimed is:

1. A system for providing an application, comprising:
- an interface configured to:
  - receive an indication to provide the application to a device;
- a hardware processor; and
- a memory coupled with the hardware processor, wherein the memory is configured to provide the hardware processor with instructions which when executed cause the hardware processor to:
  - provide the application to the device, wherein the application is configured to:
    - receive a request for a list of valid credentials;
    - determine a list of stored credentials;
    - provide the list of the stored credentials to a database system, wherein the database system is configured to:
      - determine revoked credentials, comprising to:
        - query a credential system to determine whether a revocation indication has been written to a distributed ledger network for at least one stored credential of the list of the stored credentials; and
      - determine new credentials;
    - receive an indication of the revoked credentials from the database system;
    - receive an indication of the new credentials from the database system;
    - determine the list of the valid credentials based at least in part on the list of the stored credentials, the revoked credentials, and the new credentials;
    - display the list of the valid credentials and the revoked credentials;
    - determine whether to purge metadata associated with the revoked credentials; and
    - in response to a determination that the metadata associated with the revoked credentials is to be purged, delete, from a user system, one or more of the stored credentials associated with the revoked credentials and the metadata associated with the revoked credentials.

2. The system of claim **1**, wherein the hardware processor is further configured to retrieve the new credentials.

3. The system of claim **1**, wherein the database system is further configured to revoke one or more credentials.

4. The system of claim **3**, wherein one or more new credentials are provided to the database system for identifying revoked credential information.

5. The system of claim **3**, wherein the database system is further configured to provide a set of revoked credential identifiers to the credential system.

6. The system of claim **5**, wherein the credential system is configured to:
- for each credential identifier of the set of revoked credential identifiers:
  - store an indication in a distributed ledger that the credential associated with the credential identifier is revoked.

7. The system of claim **1**, wherein the database system is configured to:
- receive the list of the stored credentials;
- provide an indication of the stored credentials to a credential server;
- receive an indication from the credential server that one or more stored credentials of the stored credentials has been revoked.

8. The system of claim **1**, wherein the stored credentials comprise credentials verifying proof of salary, proof of employment, or proof of health insurance status.

9. A method for providing an application, comprising:
- receiving an indication to provide the application to a device; and
- providing, using a processor, the application to the device, wherein the application is configured to:
  - receive a request for a list of valid credentials;
  - determine a list of stored credentials;
  - provide the list of the stored credentials to a database system, wherein the database system is configured to:
    - determine revoked credentials, comprising to:
      - query a credential system to determine whether a revocation indication has been written to a distributed ledger network for at least one stored credential of the list of the stored credentials; and
    - determine new credentials;
  - receive an indication of the revoked credentials from the database system;
  - receive an indication of the new credentials from the database system;
  - determine the list of the valid credentials based at least in part on the list of the stored credentials, the revoked credentials, and the new credentials;
  - display the list of the valid credentials and the revoked credentials;
  - determine whether to purge metadata associated with the revoked credentials; and
  - in response to a determination that the metadata associated with the revoked credentials is to be purged, delete, from a user system, one or more of the stored credentials associated with the revoked credentials and the metadata associated with the revoked credentials.

10. A computer program product for providing an application, the computer program product being embodied in a non-transitory computer readable storage medium and comprising computer instructions which when executed cause a processor to perform operations comprising:
- receiving an indication to provide the application to a device; and

providing the application to the device, wherein the application is configured to:

receive a request for a list of valid credentials;

determine a list of stored credentials;

provide the list of the stored credentials to a database system, wherein the database system is configured to:

determine revoked credentials, comprising to:

query a credential system to determine whether a revocation indication has been written to a distributed ledger network for at least one stored credential of the list of the stored credentials; and

determine new credentials;

receive an indication of the revoked credentials from the database system;

receive an indication of the new credentials from the database system;

determine the list of the valid credentials based at least in part on the list of the stored credentials, the revoked credentials, and the new credentials;

display the list of the valid credentials and the revoked credentials;

determine whether to purge metadata associated with the revoked credentials; and

in response to a determination that the metadata associated with the revoked credentials is to be purged, delete, from a user system, one or more of the stored credentials associated with the revoked credentials and the metadata associated with the revoked credentials.

11. A system for identifying revoked credential information, comprising:

an interface configured to:

receive a request for a list of valid credentials; and

a hardware processor; and

a memory coupled with the hardware processor, wherein the memory is configured to provide the hardware processor with instructions which when executed cause the hardware processor to:

determine a list of stored credentials;

provide the list of the stored credentials to a database system, wherein the database system is configured to:

determine revoked credentials, comprising to:

query a credential system to determine whether a revocation indication has been written to a distributed ledger network for at least one stored credential of the list of the stored credentials; and

determine new credentials;

receive an indication of the revoked credentials from the database system;

receive an indication of the new credentials from the database system;

determine the list of the valid credentials based at least in part on the list of the stored credentials, the revoked credentials, and the new credentials;

display the list of the valid credentials and the revoked credentials;

determine whether to purge metadata associated with the revoked credentials; and

in response to a determination that the metadata associated with the revoked credentials is to be purged, delete, from a user system, one or more of the stored credentials associated with the revoked credentials and the metadata associated with the revoked credentials.

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